Crop Protocol
Leafy Crops
spinach and cabbage

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Why grow spinach and cabbage?

Spinach:

Spinch is commonly grown in East Africa as it is very easy to grow and can be continously harvested after planting – as long as it is well fertilised and irrigated.

To maintain good yield, it is important to allow at least three larger leaves to remain intact per plant – to produce the plant energy to continuously grow more leaves. Excessive early harvesting will redcue subsequent yields as the plant will not have enough energy for continous growth.
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Spinach is better grown in the soil than in bag gardens because all plants grow better in the soil. The planting density per meter square when grown in the soil is about 40 plants per meter square – nearly the same number of plants that could be grown in a bag garden. So there is little 'space' advantage to being grown in a bag.

Fig 1: spinach

Spinach is very rich in vitamin A, folate, iron, vitamin C, vitamin B6 and vitamin E. It is therefore very good for the immune system.

	Protein	Vit A	Vit C	Vit B6	Vit E	Iron	Calcium	folate
spinach (fresh)	6	210	16	12	10	20	14	37
cow's milk	6	2	0	2	0	0	11	1

Table 1: % RDI from 100 grams of cooked spinach produce compared to cow's milk

From the above table it is clear that 100 grams of spinach has more calcium than 100 ml of milk. Spinach is also much more nutritious than milk – and much cheaper and easier to produce.

Cabbage: This crop is very widely grown in East Africa. It is rich in vitamin c and vitamin A.

	Protein	Vit A	Vit C	Vit B6	Vit E	Iron	Calcium
cabbage (fresh)	3	2	62	6	1	1	5
cabbage (dehydrated)	12	8	248	12	0	16	8

Table 2: % RDI from 100 grams of cooked cabbage produce

Planting Programme

Spinach and cabbage are considered part of the *'Leafy Crops'* in the rotation plan and are grown after the '*Legume Crop's* in the rotation (French beans or sugarsnap peas)) and before the '*Root Crops'* (carrots, onions or leeks and sweet potato).

There are two Rotation Groups – one for crops that are only in the ground for about 12 weeks (fine beans, cabbage and carrots) and one for crops that are in the ground for about 20 weeks (2 crops of French beans, continuous cropping spinach and sweet potato).

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Rotation Group	weeks in ground	LEAFY Crop	LEAFY crop planting interval	LEAFY crop area planted	ROOT crop	LEGUME crop
1	12	cabbage	4 weeks	2.5 m.sq	50% (leeks) 50%. (carrots)	1 crop of French Beans
2	20	continuous harvest spinach	2 weeks	5 m.sq	sweet potato	2 consecutive crops of French beans

Seek advice from your Real Impact agronomist on the planting interval and the meter square to be planted each time.

A general guide for a small Nutrition Garden with 20 beds, each only 10 meters long, is to plant the areas in the table above, at the weekly intervals stated.

How to grow cabbage

Crop Rotation

Cabbage crops belong to the Cruciferous family. They should not be either continuously planted in the same place or planted directly after other crops in the same family such as:

- kohlrabi
- kales
- collards

Cabbage crops are Leafy Crops so they should be planted after Legume Crops which will have' fixed' atmospheric nitrogen into the legume leaves and roots. If legume crop debris is incorporated into the soil after harvest, or made into compost and later added to the soil – this will contribute nitrogen fertilisation to the Leafy Crops.

Leafy crops need a lot of nitrogen to stimulate their vegetative growth and give higher yields.

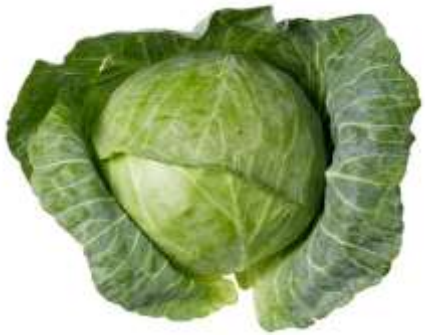

Fig 2 : Cabbage

Examples of suitable crops which could have been planted as 'previous crops' in that piece of land (and their crop debris added to the soil) include:

- runner beans
- common beans
- French beans
- peas
- cowpeas
- peanuts

Bed Preparation

- cabbage is grown on raised beds of 1.2m wide.
- Cultivate the ground to a depth of 30 cm.
- 3 rows will be planted per bed, so lay 3 drip lines equally spaced.

Fertiliser Programme

Base dressing

Focus the base fertiliser application to an area the size of a dinner plate, where the cabbages are to be transplanted. There will only be five plants per meter square, so divide the following amounts of fertiliser per meter square by five and apply as advised. This is because the cabbage does not have a good root system and the phosphate is not mobile in the soil. This makes most of the base dressing available to the plant, rather than the weeds in the bed.

- 40g of DAP per m^2 and mix well with the soil.
- vermi-fertiliser at 1 kg/m^2.
- If the crop is an organic crop and cannot use DAP – use rock phosphate according to the label and add 1 kg /m.sq of 'pile compost'.

Foliar sprays

- Vermi-liquid fertiliser at 1:10 dilution (every week)

Topdressing

When top-dressing, take care not to let the fertiliser touch the leaves of the plants to avoid scorch and use gloves when applying fertiliser

- Side dress with 40g/m^2 of CAN 3wks after transplanting.
- Repeat the application 3 weeks later.

Additional nitrogen sprays

Cabbage plants which have enough nitrogen fertiliser are a deep green colour with large leaves. If the plants appear pale in colour or a yellow/green colour instead of a deep green colour, they may require one or two urea sprays.

Good quality urea can be dissolved in water and either sprayed directly onto the leaves or to the ground. Leaves take up the nitrogen more quickly than the roots and provide a quicker growth response.

Take care not to scorch the leaves by strictly limiting the application to a 2% solution (300 grams urea in 15 litre knapsack). Never spray in the heat of the day – otherwise the crop will be damaged. Spray early morning or late afternoon (allowing enough time for the leaves to dry before nightfall – to reduce risk of downy mildew.

Seed priming and making transplants

- Soak the seeds in water for 14 hours before planting.
- Sow 2 seeds per cell at 1.0 cm depth in tray plugs

OR

- Sow seeds thinly in drills spaced 15 cm apart and cover 1 cm deep.
- 4-6 weeks later, the seedlings are ready for transplanting.
- Transplant late in the evening when sun is cool or on a cloudy day.
- Wet seedlings 1hour prior to transplanting.
- Irrigate properly to prevent wilting.

Planting Pattern

Aim for 5 plants per meter square, by planting two plants on each the outside drip lines on the edge of the bed and only one on the middle drip line.

Yield

Assuming a cabbage head has an average weight of 3 kilos and a planting density of five plants per meter square – and average yield of 15 kilos per meter square can be expected.

Harvesting

- Harvesting starts 12-16wks from planting by cutting heads with a knife.
- Harvest cabbage when heads are firm and weigh 2-4kg with 4 wrapper leaves.

Storage

- Un-bruised cabbages can store for 8 weeks without cold storage.
- Remove any damaged or diseased leaves before storage
- Space cabbages out on a shelf in a charcoal cooler room for optimum shelf life, in the dark.

MAIN CABBAGE PESTS

Diamond Back Moth

The caterpillars feed on the leaves, making large holes

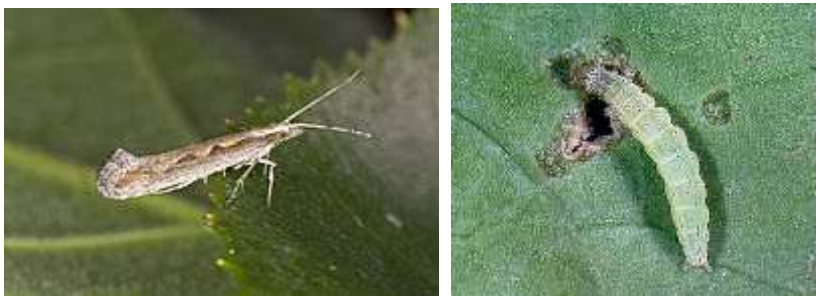

Fig 3 Diamond back moth adult (left) lava (right)

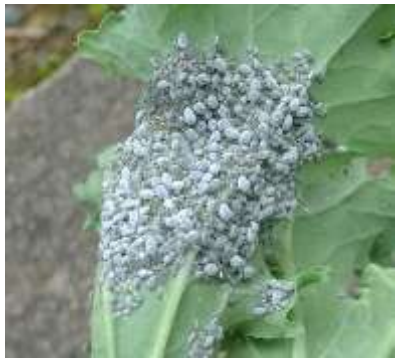

Fig 4 : cabbage aphids

Other cabbage pests

These include whitefly and thrips.

Cabbage aphid

These aphids form dense colonies on the leaves. The aphids are rather 'waxy' and difficult to kill with pesticides. A wetting agent is helpful to assist the pesticides to penetrate. Teepol is a good wetting agent, as well as providing some control, if applied in high volume sprays, frequently.

MAIN CABBAGE DISEASES

Downy mildew

Fig : downy mildew on cabbage

Fig : Alternaria on cabbage

Pest sprays

Caterpillars can be picked off by hand and squashed if the farmer has only a very small plot. Close attention to the plants and checking for holes in the leaves (signs of caterpillar feeding) or patches of aphids, will ensure clean plants and high yields.

If water is available, high pressure water jets will even wash caterpillars and aphids off the leaf. Do this in the early morning, not in the heat of the day to avoid scorching plants. Sprays made with diluted Teepol detergent will help control aphids (75 ml Teepol in 15 L knapsack). However, the above control measures must be applied frequently (twice per week) if pest pressure is high.

However, if pest pressure increases, use a pesticide as suggested below. But ALWAYS READ THE LABEL and check the application rates and Pre Harvest Intervals. Take responsibility to ensure safe application, use protective equipment as advised by the Label.

Uwezo

Syngenta make a series of good quality, reliable pesticides in pack sizes suitable for small-scale farmers – the series is called UWEZO. Uwezo is stocked by most agrovets. The pack sizes are sufficient to use in one 15 litre spray tank.

Check the Labels and use the product specific to the pest present. Do not spray if the pest levels are not high. Observe all health and safety instruction and leave the recommended number of days after spraying – before picking any produce

How to grow spinach

Crop Rotation

Spinach/Swiss chards belong to the *Chenopodiaceae* family. They should not be either continuously planted in the same place or planted directly after other crops in the same family such as:

- beetroot

Spinach/Swiss chards are leafy crops so they should be planted after legumes as explained above. Examples of suitable crops, which could have been planted as 'previous crops' in the same piece of land include;

- runner beans
- other types of beans
- French beans
- peas
- cowpeas

Bed Preparation

- Spinach is grown on raised beds of 1.2m wide.
- Cultivate the ground to a depth of 20 cm.
- 6 rows will be planted per bed, so lay 3 drip lines equally spaced

Planting Pattern

- Plant two rows of spinach plants per drip line – at 15 cm spacings. This makes a total of 40 plants per meter square
- Alternate the planting position in the two rows next to the same drip line to make a zig-zag pattern. This gives each plant more space and reduces competition.

Making transplants

Spinach can be planted by direct seeding, but transplanting seedlings gives them a better start and is worth the effort.

Seed priming and planting

- soak seeds in water for 24 hours before planting.
- sow 2 seeds per plug cell, 1cm deep
- 4-6 weeks later, transplant seedlings.
- wet seedlings 1 hour to transplanting.
- transplant late in the evening or on a cloudy or cool day.

Transplanting

First irrigate the transplants when still in the seed trays – then carefully remove individual plants and press them carefully into a depression made in the planting position by pushing your thumb into the soil

Try not to plant the transplant any deeper in the soil than it was in the seed tray. Also make sure the plant is not planted too shallow, or the roots will dry out. It should be planted so that the surface of compost of the seed tray is level with the surface of the soil.

Firm the transplant in well, so that the roots are in good contact with the soil and then irrigate daily by watering can for a week to ensure they establish quickly. After this period, use drip irrigation.

Yields

The stem and the green leafy section can be consumed. With a planting density of 40 plants per meter square and a continuous harvest method, very high yields can be obtained, as long as regular water and fertiliser are applied.

The spinach can begin harvest (one or two leaves per week) from a bout weeks 6 after transplanting. The crop is in the ground for 20 weeks, so this is a harvest period of 14 weeks. Using transplants instead of direct seeding, reduces the time to wait before harvest can begin. This also uses less water in establishing the plants – as there is less water lost from evaporation in the propagation trays.

If each plant produces 2 leaves per week over a 14-week period – then one meter square can produce 1,120 leaves.

Harvesting

- Harvesting commences about 6-8 weeks from planting (depending on whether it is transplanted or direct seeded), once the plant is large enough to continue to grow, even though leaves are being continually removed.
- As long as not too many leaves are removed at any one time, the harvest period may continue for 14 weeks or more.
- Take care not to damage the plant when harvesting leaves – gently snap off the leaf at the very base of the leaf stalk. Try not to leave a broken end of a stem behind because this could be a point where plant diseases enter the plant.
- The leaves are harvested with the stalk intact
- There must always be at least 2 large leaves per plant, remaining after the harvest – to ensure the plant can continue to make new leaves.
- Remove any diseases leaves and eat these first or put them on the compost heap – to stop any diseases spreading.

Post-harvest

Spinach does not store well and should be eaten freshly harvested.
However, it is possible to dehydrate spinach to enable growers to store bumper harvests and use the dried spinach during periods when there are less fresh vegetables available.

Freshly harvested leaves

- Put the washed and dried harvested leaves into a polythene bag and store at 4^0 C in a fridge (shelf life-3days).

Dehydrating leaves

- Wash spinach well and remove stems.
- Dehydrate spinach at 37° C for 10 hours or until brittle.
- Store dried spinach in a clean, dry, airtight container, in a cool dark location. (light can cause discoloration)

Fertilizer and crop protection program

Use the same programme suggested for cabbage

MAIN SPINACH PESTS

Leaf miner

Leafminer is a fly which lays eggs in the leaf. Eggs hatch into a larvae which feed by tunnelling through the leaf, making the characteristic mines.

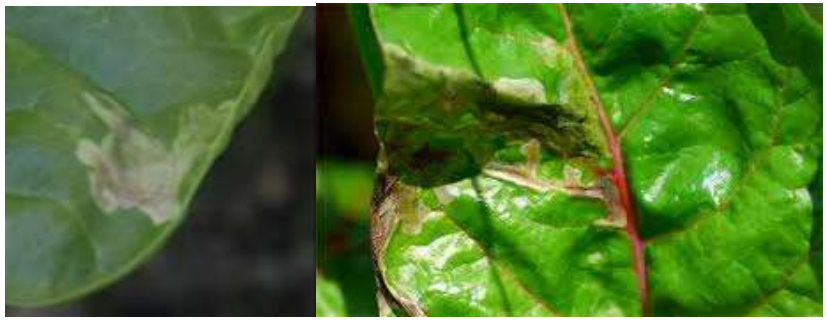

Fig: Leafminer damage to spinach and chard leaves

It is not however, normally necessary to spray for this pest because the natural enemy, Diglyphus, is very common and can easily control the pest. .

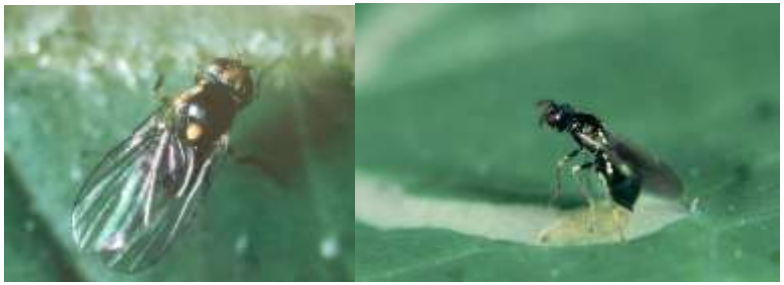

Fig: Leafminer adult (left) Diglyphus adult (right) laying and egg in a leafminer larvae in the leaf

Diglyphus is a parasitic wasp that lays an egg in the tunnelling leafminer larvae in the leaf. However compatible sprays need to be used for other pests to make sure the Diglyphus is not killed and are present in high enough numbers to have an effect on leafminer.

Metarhizium is compatible with Diglyphus pupae and larvae and (if drenched in the soil) will also kill leafminer adult flies and leafminer pupae which are in the soil.

Other spinach pests

Spinach can also be attacked by thrips, aphids and flea beetles.

MAIN SPINACH DISEASES

Cercospora leaf spot

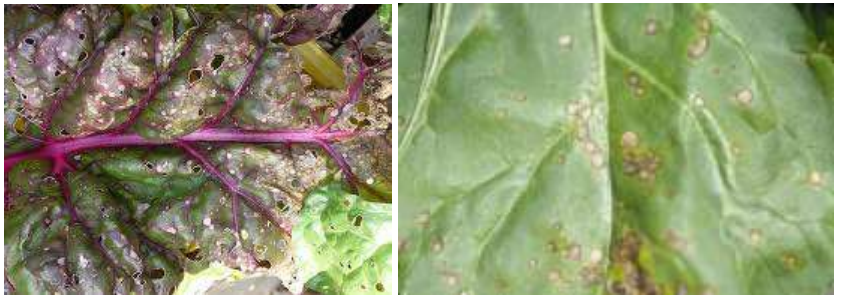

Fig : *Cercospora* leaf spot

Other spinach diseases

These include downy mildew, damping off and Tomato Spotted Wilt Virus